

Problems and countermeasures on restoration of forest ecological environment of Jilin Province

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Abstract: Jilin Province is one of major forest regions of China. This paper analyzed the existing conditions and tendency in forest ecological restoration of the province and revealed the confronting problems in ecology and economy. The authors divided Jilin Province into three ecological economic zones, including mid-west farming and stockbreeding area, east hilly diversified-operation area, and Changbai Mountain national forest area, and discussed the direction and tasks of forest ecological restoration of each zone. Some Countermeasures and suggestions were put forward for restoration of forest ecology of the province.

Key words: Jilin, Forest ecological restoration, Sustainable development, Forest resources, Forestry countermeasures

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Essential conditions

Jilin Province, as one of major forest regions and productive bases of China, is rich in forest resource. The area of forestry-used land, area of forested land and covering rate of forest, stock volume, and the output volume of wood rank the province twelfth, eighth, sixth, and second, respectively in the whole nation. The forestry-used land in the whole province is 9.676 million hm², making up 51.9% of total land of Jilin, of which forested land is 7.977 million hm² and growing stock is 840 million m³, and forest cover rate is up 42.5% (Jia 1994; Xing 1998).

During the past fifty years, great achievements have been made in the restoration of forest ecological system, which has remarkably contributed to ecological environment and sustainable development of national economy for Jilin Province, even for the whole region. At the end of 1995, Jilin Province accomplished the task of planting trees in and around the city two years ahead of time, and nearly there are no wastelands and bare hills in the whole province. Particularly, the project of "Three North" Protective Forest System in Jilin has made world famous achievement in breaking wind, fixing sand, and in improving agricultural ecological environment. In addition, the tremendous and positive effect of this project has made grain yield continually increase. The area of sandy wasteland in western and central areas of Jilin has been dropped from 7.33 million hm² to 0.31 million hm² since 1978, and

the situation 'sand forward, man backward' has been essentially controlled. Changbai Mountain forest region is not only the productive base of national timber and forest special products, but also a green ecological defense. Generally speaking, without this green ecological defense to conserve water source, prevent low hills, gentle mound, and valley from soil erosion and to improve ecological environment of Songliao Plain and Songnen Plain, the sources and courses of Songhua River, Tumen River, Yalu River, and Xuifen River would not exist and the prospect of corn stripe in central Songliao Plain and granary in north-east would both be worse than anything imaginable.

Although we have made great achievements on afforestation and on restoration of forest ecosystem, it must be admitted that there still exist very large disparity and lots of problems on constructing forest ecological environment. Obviously, it should be noticed that a few natural calamities happened frequently. For example, a catastrophic flood happened in the east of Jilin in 1995, the same case was present in the west of Jilin in 1998, and a serious spring-summer drought happened in 1997. Besides some uncontrolled natural factors such as atmospheric circulation, and weak irrigation works, the frequent occurrence of natural calamities was also attributable to the potential problems of forest ecology (Qiu 1989; Ma 1988, Gao 1995; Wu 1991).

The existing problems

Forest ecological system is degenerating.

Changbai Mountain forest region, which is always called Changbai immense forest, making up roughly four-fifth of the total forest resources of Jilin, is not only timber productive base of nation, but also a green ecological defense of northeast region and Inner Mongolia. However, owing to long-term centralized and excessive cutting, the virgin forest nearly disappeared in this region except Changbai

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Natural Reserve. Especially once a period, clear-cutting system of the whole area was adopted, which made the mixed broadleaves and coniferous forest that is the climax community in this region be replaced by the second growth forest, artificial forest and over-cutting forest. According to statistics, during a ten-year period from 1986 to 1996, the area of natural secondary forest of Changbai Mountain national forest region increased from 9.05 million to 1.72 million hm², or increasing 90 percent. It is clear that a great number of near-mature virgin forest resources has degenerated by man and became natural second growth stand. There is only 1270,00 hm² of steady over-mature forest to be left for the whole forest industry system of Jilin Province, which merely accounts for 6% of natural timber forest (Wang 2001).

Stability of forest ecological system is demoting.

Since a great number of virgin forest resource which were part of climax community have been damaged by man, as a result, the steady forest ecological system of Changbai Mountain region lost the balance. According to the statistics, from 1986 to 1996, the area of the artificial forest of Changbai Mountain national forest region increased from 103,000 hm² to 431,000 hm², that of local artificial forest in eastern part of the province increased from 487,000 hm² to 901,000 hm², and the area of "Three North" Protective Forest increased from 355,000 hm² to 851,000 hm² during the same time. About 80 percent of the artificial forests in national forest region and eastern local areas are mainly composed of conifers in which larch takes the main body, while as to "Three North" Protective Forest, 90 percent of the artificial forests are poplar plantations and almost are pure stands. We should notice that pure stand is a internal cause that result in frequently occurring disease, pest and mouse, and this is also a inevitable outcome resulted form steady forest ecosystem being damaged (Bai 2000; Wang 1989, 1992).

In addition, as a result of virgin forests being replaced by over-cutting forest and second growth and large area of mixed broadleaved and coniferous forest having vanished, the forest ecosystem lose inherent ecological balance and forest community changed from steady forest category to contrary side (Qiu 1989; Wu 1991).

Forest biological diversity is reducing.

Over-exploitation and utilization must lead to reducing of forest biological diversity. It must be pointed out that clear-cutting system of the whole area, which was widely adopted by forest industry enterprises of Changbai Mountain national forest region in the proceeding period, has given us bitter experience. This productive model violated the principle of biological diversity, thus resulting in vanishing of a large number of rare species, economic plants, and genetic genes, and even leading to immense damage of forest ecological environment and vicious circle of forest reproduction.

Apart from resources of natural rare local tree species such as Korean Pine (*Pinus koraiensis*), Manchurian Ash (*Fraxinus mandshurica*), Manchurian Walnut (*Juglans mandshurica*), and Amur Corktree (*Phellodendron amurense*), etc. have been considerably lessening, other kinds of nature rare species such as Japanese Yew (*Taxus cuspidata*) and Manchurian catalpa (*Catalpa bungei*) have almost been on the verge of extinct. In addition, it is difficult to see some kinds of previous wild lives, such as wild ginseng and cold-water fish. According to the relevant survey, the number of Northeast tiger distributed in Jilin Province has dropped from more than 20 in 1980's to 7-9 in 1990's and their living regions are reducing. If we do not make remediable and protective measures at once, they will vanish in Changbai Mountain. Furthermore, because of indiscriminately digging medicinal plants and edible wild herbs, some kinds of economical plant resources have seriously decreased, and even vanished.

Forest landscape is tending towards fragment.

According to the survey made in 1949, the area and the volume of virgin timber forest made up 48.6% and 65.7% respectively of total area and total volume of forest in the whole province. At that time, the ecological landscape was virgin forest in essential, with very few pieced forest and drag roads, and fragmental ecological environment were seldom seen. Until 1986, the area of mature and over-mature forest had decreased to 29.1% and forest volume also had decreased to 49.8%, and even dropped respectively to 14.9% and 27.8% until 1996, as a result, thoroughly changes in forest landscape had taken place, and the basis of forest landscape had been replaced by middle-aged and young natural forests. The collective and excessive over-cutting caused original forest landscape being seriously interfered and destroyed, therefore, until now landscape have been in state of broken and fragmental appearance. This phenomenon displays specially projecting in densely populated area (see Table 1).

The function of forest ecology is declining.

The clear-cutting of whole area that was carried out in Changbai Mountain region seriously destroyed the function of forest ecology in water and soil conservation. In the past fifty years, the covering rate of forest of Hailan River valley in Yanbian district had dropped from 80% to 45.4%, and runoff capacity of rivers had decreased near two-thirds. After clear-cutting, serious soil erosion have taken place on arable hill-land (Wang 1992).

According to the statistics from meteorology department, with enlarging of the cutting area of virgin forest and quickening of the cutting speed, the frequency of drought and water logging for Jilin Province increased from 12% to over 38% in the past 150 years. Since 1986, five serious floods have happened in Changbai Mountain region; among them an extraordinarily serious one happened in 1995, with directly economic loss of more than 10 billion yuan. In

yuan. In addition, drought in spring and summer frequently happened in the late ten years. We can't say that it has nothing to do with disappearing of large area of virgin for-

ests and degenerating of forest ecological function (Zhang 1986).

Table 1. The changes in forest landscape of Jilin Province in 1980s and 1990s (Jia 1994; Xing 1998; Wang 1989)

Region	1986		1996	
	Small Pieces of forest	Averaged area for each piece /hm ²	Small Pieces of forest	Averaged area for each piece /hm ²
Daheishan	14	15509.4	29	7182.4
Changchun	19		61	3712.1
Siping	28		91	2829.3
Liaoyuan	32		63	3097.0
Baicheng	53		68	3786.3
Songyuan	35		52	4668.3

In the light of factual proof, different types of vegetation have marked difference in capacity of water conversation. The virgin forests with good community structure and high productivity have degenerated to heavily damaged secondary forest, which brought about us an ecological damage not to be ignored. Total water capacities of the virgin forest communities by representative of *Quercus mongolica*—Korean pine forest, *Betula costata*—Korean pine forest and Amur Linden—Korean pine forest can be up to 3228.44 t/hm², which is 76.49 tons more than that of the natural secondary forests including hardwood, *Betula platyphylla* stand, poplar stand, and *Betula costata* stand and is 453.94 tons more than that of the artificial forests including Korean pine plantation, Dahurian Larch plantation and Scotch pine plantation.

According to factual proof above, the problems of ecological environment in Jilin are still severe. It will bring about serious consequences to sustainable development of national economy if they are not solved. Thus, high attention must be paid to these problems.

Direction and mission of forest ecological restoration

From Jilin Province's reality, we can divide the province into three ecological economic regions: Mid-west farming and stockbreeding area, Eastern hilly diversified-operation area, and Changbai Mountain national forest area (Wang 2001a, 2001b).

Mid-west farming and stockbreeding area

The mid-west area of Jilin Province is a key zone of "Three North" Protective Forest System. The basic mission in forest ecology for this area is to energetically establish protective forest system that takes farmland shelterbelt and windbreak and sand fixation forest as main body, improve ecological environment and accelerate development of farming and stockbreeding. Although construction of protective forest system in this area has made remarkable achievement, the frail ecological conditions have not been changed for all. There still exist some problems such as relatively low covering rate of forest, poor stand quality,

fairly simple species, rather irrational structure, and relatively poor benefit of ecological economy, etc. For this reason, we must thoroughly improve ecological conditions of farming and stockbreeding, energetically develop intensive forest used by agriculture, build up agro-forestry system, make a good job of protective forest system according to model for ecological economy, hence push farming and stockbreeding towards direction of good quality, high efficiency, stability, coordination and continuation (Qiu 1989; Ma 1988).

For energetically developing intensive agroforestry, the construction work of "Three North" Protective System in this area must focus on transforming from quantity to quality, that is to say, we must give consideration to both ecological economic function and productive potentialities. Combining with engineering of controlling sand and soda, we should make a good job of selecting fine tree species such as drought-enduring, water-tolerance, and saline-alkali-resisting species. Around restoration of protective forest, timber forest, economic forest, fuel wood forest, forage forest, we must make a good job of structure of forest and species, including combination of belt, network, and piece, combination of arbor, brush and grass, and combination of conifer, broadleaf and mixture. Base on diversity and stability of ecological landscape, we should regulate the structure of farming, forestry, and animal husbandry, thus combining forest with grains, fruits, glasses, stock raising, medicinal materials, and by-products.

East hilly diversified-operation area

Eastern hilly-area of Jilin, with typical secondary forest, mainly run along banks and source of Songhua River, Dongliao River and Huifa River, the soil and water erosion are rather serious. This area is fairly rich in forest resource. Besides woods resource, there are a large number of wild economic plants, economic animals, and medicinal used or edible fungus as well as tour resources. In order to achieve developmental goal, we should enhance protection of the existing forest resource, improve forest quality, and promote succession of secondary forest community towards climax community. Furthermore, we should bring the functions of forest in soil and water conservation and ecological

economy into full play, energetically develop diversified operation based on forest, and comprehensively exploit and utilize forest resource, in order to improve sustainable development of regional social economy.

According to request of modern forest and market economy, in order to make forest ecological restoration well in this region, we must adhere to developing ecological economic forest. That is to say, under the premise of protecting forest resource and controlling soil and water erosion, we should fully tap productive potentialities of forested land and pay close attention to ecological economic structure. For this reason, governments at all levels must strengthen protection and development of forest resource and make good restoration of green ecological defense which emphasis on water and soil conservation. We should do away with traditional forest customs, that is "only to see trees, not to see forest", and regulate the train of thought for forestry construction according to ideas of modern forest.

At present, we should put emphasis on reclaiming forest from cultivated land and on making efficient use of low-quality forestland and building forest belt for protecting slope. Under the presupposition of protection, we could comprehensively exploit and scientifically utilize wild plant and animal resources, to make coordinative development of regional ecology and economy.

Changbai Mountain national forest area

Changbai Mountain national forest area, with nearly four-fifths forest resources of Jilin Province, is not only national productive base of timber but also green ecological defense of the Songliao Plain in northeast region. To protect and improve forest ecological environment here, raise forest quality, and to restore function of forest ecological system are of vital importance not only to sustainable development of social economy of Jilin Province but also to ecological balance and economical restoration of the whole northeast region of China. Therefore, the restoration of forest ecology of this area must accord to national request, with an emphasis on implement of protective engineering of natural forest. Under the prerequisite to bring the green defense and ecological benefit of existing forest resource into full play, we should restore the natural forest that bore over-cutting.

Eighteen national silviculture bureaus and four local silviculture bureaus in Changbai Mountain national forest area are listed in natural forest protection project. The emphasis for restoring forest ecology is to protect and develop forest resource at the sources of big rivers. We should strengthen protecting forest resource, limiting or prohibiting forest cutting, and enforce restoration of forest vegetation and bio-diversity. In process of carrying out the project of natural forest protection, we should do well classified management of national forest resource and do directional growing and managing. Ecological public forest is consist of all kinds of protective forests, which is the main

part of forest ecological restoration's system, and its proportion should be above 70%, or more. The exploiting method like "kill the hen to get the eggs" is prohibited. Commercial forest should be planted at the section of an area where have good site condition and transport facilities and be intensively managed, so as to ensure needs of national economic construction as well as the demand of people living for forest products. The proportion of commercial forest should be below 30 percent. Ecological public forests generally belong to transitional forest bearing on ecological and economic benefits, expect those in the areas of river's source and steep slope, and it is allowed to make adequate amount of wood production under the prerequisite to fully playing ecological benefit. Through enforcing nature forest protective engineering, we can make the most of Changbai Mountain forest in ecological economy and green ecological defense.

Countermeasures and suggestions

Raising ecological consciousness

Forest is the majority of land ecological system, also is ecological environment and 'green treasure-house' on which human being 's living and developing depend. Developed forestry is one of the symbols of prosperity, prosperous, and social civilization for a nation.

We should recognize that forest is a public good undertaking. Ecological restoration is the most important task of forestry. Leaders at all different levels must overcome narrow economic standpoint, short-term behaviors, and one-sided knowledge for forest work. In the past, we put undue stress on pursuing direct economic benefit of forestry restoration. This is the basic reason that caused deteriorating forest ecological environment at Changbai Mountain national forest area and vicious circle of forestry reproduction. Furthermore, it is also the cause that makes forestry restoration difficultly in mid-west of Jilin Province.

It should be noticed that the agriculture of Jilin relatively depends on forestry. Changbai Mountain, the green forest ecological defense, is a good shelter for black cultivated land of Songliao plain in northeast area. To appraise contribution and standing position of forestry, we should not base on how many timbers forestry institution can produce or how much taxes they can pay. Only from the view of ecological and sustainable development of social economy can we carry on restoration of forest ecosystem well in order to benefit future generations and can we let restoration of forest ecological environment make a leap.

Strengthening construction of commercial forest base and cultivating of reserve forest resource

Commercial forest base will shoulder timber product's burden in future after the protective engineering of nature forest is put into operation in national forest area. At present, the existing productive capacity of commercial forest is far from the standard of request. We should put close

attention to improved seeds' introducing and growing and strengthen study and extending of intensive management technology and transformation of achievement in scientific research. In addition, we should ensure investment in commercial forest management. In New Zealand, 90 percent of timbers are output from artificial forest, but the area of artificial forest only makes up 11 percent of the whole area of forest. New Zealand has transformed major importer of timber into exporter depending on improved species, advanced management and quite high investment.

Enhancing investment in forest ecological restoration

Forest ecological restoration is a public undertaking. It should be supported by nation and all society. Expenditure of forestry ecosystem restoration used to renovating national land should be invested by financial departments at different levels except nation appropriate funds, thus making up a multivariable investing channel of forest ecological restoration.

At present, funds for forestry construction are inadequate, especially for forest ecological restoration. Social burden of forest industrial departments in Changbai Mountain national forest region is over weight. The current national policy of natural forest protection can only solve some difficulties brought by timber product's reduction, but no more funds serve restoration of forest ecological environment. In mid-west of Jilin, many forestry staff and workers can not do normal forestry work and have to cultivate barren hills, due to that timber production of forest enterprise is reducing by a big margin and the planting funds is not adequate. Considering public and social characteristics of forestry restoration, our national government should lay down forestry police and measures beneficial to restoration of forest ecosystem, such as remitting taxation of forest production, collecting fees of forest ecological benefit, and building funds for development of forest ecological restoration, to alleviate the problems in funds.

Increasing scientific and technical content of forest ecological restoration

Forest ecological restoration is complex system engineering, and its success depends on improvement of science and technology (Dong 1992). In order to promote restoration of forest ecology in Jilin Province, we should thoroughly understand target system and master crucial technical problem to improve forest ecological function. Up to date, for the "three North" Protective Forest in central and west of Jilin, the emphasis is put mainly on survival rate, conserving rate and cover rate but not on that how to raise covering quality and fully give play to function of forest ecology. The forest management in Changbai national forest area and local forestry still stresses on forest volume and increment but not on forest quality and improvement of forest ecology. Only thoroughly researching the quality of forest covering, type of forest ecology, structure of forest community, forest ecological function and so on and in-

creasing technical content of forest protection, cultivation and management, can we do our work well in restoration of forest ecological environment.

Compared with agriculture, the whole level of forestry in science and technology in Jilin is far from advanced standard, and technical content of forest restoration are still quite low, so it is very important to strengthen scientific and technical work and improve quality of forestry workers.

Managing forest resources according to law

At present, forestry restoration in Jilin province is in a crucial state of development. Under the condition of socialism market economy, the management of forest resource is facing with new situations and new problems. No matter that it is national, collective or private forest resources, both material value and ecological value must be considered. Therefore, forest resource must be unitedly administered by national or provincial forestry agencies, and destructive cutting is always forbidden.

In addition to tree resource included, forest resource also includes wild animals, plants, and microorganism resources relying on forest environment. Responsible administrators of forest resource should pay special attention to protection and restoration of forest ecological environment. We can exercise proprietary rights for management of national forest resource and perform property rights for managing non-state-owned forest resource by representing state. In short, we must manage forest resource and improve forest ecological environment according to law. This administrative authority is a kind of governmental behavior, and it should not be distributed or transferred to non-national authorities.

Building up operation mechanism adaptive to market economy

Forest ecosystem and restoration of forest ecological environment should not be engaged in exclusively. We need bring every positive factor into play. At present, some cities and towns are carrying out contracting of forest protection and management. This is a beneficial approach for protecting and growing forest resource. Forestry workers take charge of protecting forest at the same time of managing side-occupation of forest.

For carrying out contracting of forest protection and management, proceeding from forest feature and reality we have to draw up stable policy with a certain continuity. The contracting for forest management at least lasts thirty years. During the effective period of contract, the newly increasing part of forest resource could be shared on basis of interests, and it is allowable for manager to carry out diversified operation under the premise of protecting forest resource well.

Setting and perfecting target system of forestry ecological restoration

Large population in forest areas and huge consumption

of timber and forest products by national construction and people living bring large pressure to forest ecological restoration. Under this premise, preservation of forest ecological environment conflicts with exploiting and utilization of forest resources to a certain degree. In order to solve this contradictory, we must set regional sustainable development as a goal and build up and perfect the target system of forestry ecological restoration. In the light of the target system and proceeding from actual condition, we must lay down standards of ecological restoration and implement leaders' responsibility system at all levels. Only in this way can we promote forest ecological restoration and accomplish strategic goal of sustainable development of forestry and social economy.

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